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(54) Automatic control system of press compaction.

(57) It is especially applicable in the manufacture of tiles and pavement, obtaining these pieces upon compacting the granulate material (3) with a specific percentage of moisture, then followed by a drying, enameling, painting treatment, etc. and even kiln firing.

The automatic control of compaction takes place upon distributing pressure sensors (1) in the mold itself of the press, built in the top (2) or bottom (3) punch, whereby making it possible to obtain data when pressing takes place.

Therefore, the stability of the load is statistically controlled upon the sensors (1) communicating the force measured in differences of voltage, transforming these values into signals for a computer, by means of an amplifying system, processing these data to elaborate statistical values, etc., thus continuously informing about the pressing quality.

The load correction is done by means of the intelligent feed slide that feeds the press that receives the corresponding orders with the value packages obtained by statistical evaluation.

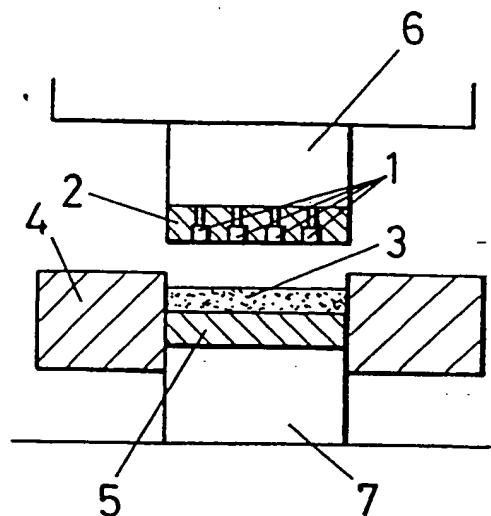


FIG. 1

EP 0 594 227 A1

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## OBJECT OF THE INVENTION

As is expressed in the title of this specification, the present invention refers to an automatic control system of press compaction, being especially applicable to the manufacture of tiles and pavements.

In the manufacture of ceramics, pieces are produced in dry presses, compacting a granulate material with a specific moisture, to thus attain solidly compacted pieces that endure, after being pressed, drying, enameling, painting, belt conveyance treatments, etc., even kiln firing, where they receive, by means of high temperatures, the definitive feature and resistance.

The homogeneity of the product with regard to correct compaction is very important for the physical resistance of the pieces during the drying and firing process and when a product contracts during firing, it is even more important, since any difference of compaction would cause contraction differences, in other words, deformed pieces would be produced.

The purpose of this invention is to attain an automatic control system of compaction and at the same time rapid, without the need of taking samples. With the data obtained continuously and automatically, very reliable and exact control of production can be achieved, since upon continuously having data after each pressing, statistically based decisions may be made, elaborating values based on many consecutive pressings, and in the event of adjustment by means of an intelligent feed slide, the load correction orders will also be considered on the grounds of many consecutive pressings and the possibility of mistakes upon processing non-representative values is eliminated.

## BACKGROUND OF THE INVENTION

In the processes used up until now, in the one shown in patent 541.518 which claims a penetrometer to determine the density of the compacted ceramic piece, as well as the one developed by immersion in mercury in patent of invention P-8800227, both of the same applicant as of the present invention, the process is based on taking samples and therefore it is slow. No continuous control of production can be made and there is the risk that any sample taken does not represent true production, due to an instant load failure.

Patent of invention number P-8901208, also of the same applicant firm, refers to an intelligent feed slide to carry out the correction of load of ceramic material on the basis of a series of samples taken by hand.

## DESCRIPTION OF THE INVENTION

The automatic control system of press compaction that is the object of the invention, makes it possible to obtain data about the compaction directly when pressing takes place by distribution of pressure sensors installed in the press mold itself.

In this way data of each pressing are obtained which makes it possible to control the load stability statistically. In other words, data of a single pressing (or sample) will not be taken for the evaluation of the load, but rather an entire series of pressings that may be few or many, depending on the load stability, in order to consider the load quality.

In order to carry out this control, pressure or force sensors, of the type used on the market, are installed in a mold punch, which may be a top or bottom punch.

When the compacting is done, when the top punch penetrates into the mold to compact the granulate material contained in it, the sensors measure the reactive force of the granulate material. Where there was a denser load, the compaction will logically be greater and the sensor in such an area will measure a higher force. Likewise, when it is an area with a smaller load, the compaction will be less and the sensor will measure a smaller force.

The sensors communicate the force measured in current or voltage differences and an amplifying system converts these values into signals for a computer where the data will be processed to elaborate statistical values, etc.

The data elaborated by the computer continuously inform about the pressing quality:

- Whether or not the load is stable. Load irregularities are discovered with percentage values thereof, for example: 80% correct load, 10% somewhat defective and 10% very defective.
- Whether the distribution of compaction is homogeneous and within the established limits thereof.

These same data are used to correct the load by means of the intelligent feed slide. A data package is elaborated and sent by communication cable to the microprocessor control of the intelligent slide to correct defective load areas.

As this data package is the statistical result of a series of pressings, there is no possibility of an erroneous correction as when the data are elaborated on the basis of samples taken by hand, as is presently done.

In order to permit a better understanding of the features of the invention and forming an integral part of this specification, a sheet of drawings in whose figures, with an illustrative and non-restrictive manner the following has been represented, is

attached hereto:

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 and 2.- They schematically show the automatic control system of press compaction, when the sensors are located in the top punch and the positions before and after compaction, respectively, have been represented.

Figures 3 and 4.- They are schematic views similar to figures 1 and 2, with the sensors installed in the bottom punch.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

Making reference to the numbering used in the figures, we can see how the automatic control system of press compaction, which the invention proposes, makes it possible to control the pressing of ceramic pieces of tile and pavement, by means of sensors (1) installed in the top punch (2) of the press. The ceramic granulate material (3) is located inside the mold (4) upon the bottom punch (5.)

References (6) and (7) respectively show the supports for the top punch (2) and bottom punch (5.)

In figures 1 and 2 we can see the sensors (1) located in the top punch (2), while in figures 3 and 4, we can see the same sensors (2) coupled to the bottom punch (5.)

When the granulate material (3) has been pressed, as shown in figures 2 and 4, irrespective of the fact whether the sensors (1) are located in the top punch (2) or in the bottom one (5), when the top punch penetrates into the mold (4) and compacts the granulate material, the sensors measure the reactive force of the granulate material, shown with vertical arrows that are directed towards the sensors (1.)

This force is measured in voltage differences, and an amplifying system converts these values into signals for a processor, in such a way that the data are processed to elaborate statistical values, etc. thus continuously informing about the pressing quality.

#### Claims

1. Automatic control system of press compaction, especially applicable in the manufacture of tiles and pavement, where the pieces are produced in dry presses, compacting a granulate material (3) with a specific moisture to endure drying, enameling, painting, belt conveyance treatments, and even kiln firing where the definitive resistance and feature are achieved, characterized because compaction data are

obtained directly when pressing takes place, upon distributing pressure sensors (1) in the press mold itself, built in the top (2) or bottom (5) punch thereof, which makes it possible to control the load stability statistically, the sensors (1) communicating the force measured in voltage differences.

2. Automatic control system of press compaction, according to claim 1, characterized because there is an amplifying system that converts these values into signals for a computer, where the data will be processed to elaborate statistical values, etc., continuously informing about the pressing quality.
3. Automatic control system of press compaction, according to claim 1, characterized because the load correction is carried out by means of an intelligent feed slide that feeds the press, upon receiving the corresponding orders with value packages obtained by statistical evaluation.

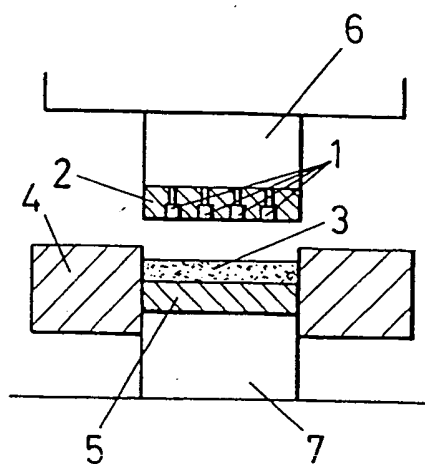


FIG. 1

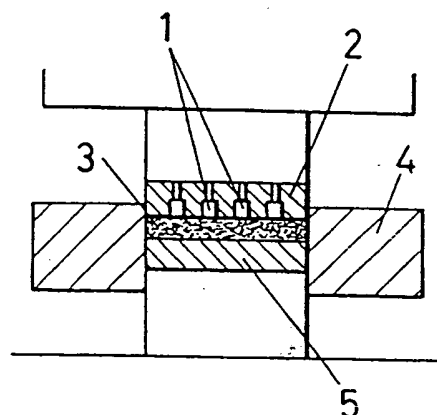


FIG. 2

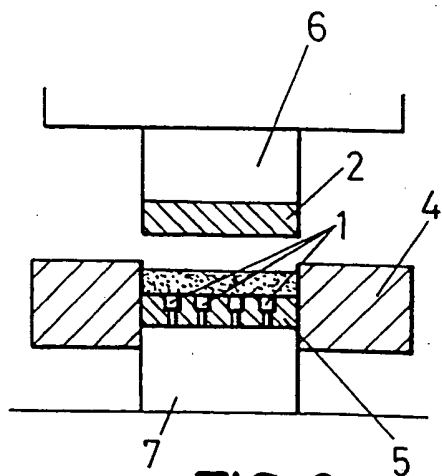


FIG. 3

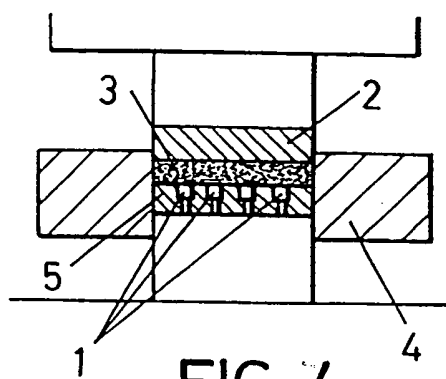


FIG. 4



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# EUROPEAN SEARCH REPORT

Application Number

EP 93 20 0977

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-A-2 915 966 (LAEIS-WERKE) * the whole document *	1-3	B30B11/02 B28B3/02
X	DE-A-2 831 166 (DORSTENER MASCHINENFABRIK AG) * claims; figures *	1-3	
X	CH-A-668 032 (LAEIS GMBH) * claims; figures *	1-2	
A	DE-A-3 109 567 (MESSERSCHMITT-BÖLKOW-BLOHM GMBH) * claims; figures *	1	
A	DE-B-2 742 571 (WILHELM FETTE GMBH) * column 2, line 11 - line 27; claims 1-4 *	1-3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B30B B28B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 JUNE 1993	Examiner VOUTSADOPOULOS K.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons * : member of the same patent family, corresponding document	

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WPI Acc No: 94-350936/199444

XRPX Acc No: N94-275368

Approximation function generator used in calculation of functions e.g.  
Sine - uses iterative determination of linear regression function that  
gives least error over all inputs to predict approximate data

Patent Assignee: LAB ELECTRONIQUE PHILIPS (PHIG ); PHILIPS ELECTRONICS NV  
(PHIG ); LAB ELECTRONIQUE PHILIPS SA (PHIG ); US PHILIPS CORP (PHIG )

Inventor: DEVILLE Y

Number of Countries: 002 Number of Patents: 003

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Main IPC	Week
EP 624847	A1	19941117	EP 94201267	A	19940506	G06F-015/353	199444 B
FR 2705155	A1	19941118	FR 935715	A	19930512	G06F-015/353	199501
US 5519647	A	19960521	US 94241088	A	19940511	G06F-001/02	199626

Priority Applications (No Type Date): FR 935715 A 19930512

Cited Patents: 04Jnl.Ref; US 4774685

Patent Details:

Patent	Kind	Lan	Pg	Filing	Notes	Application	Patent
EP 624847	A1	F	24				
US 5519647	A		19				

Abstract (Basic): EP 624847 A

The generator produces an approximation function based on pairs of values (Xi,Yi) associating a dependent magnitude (Yi) with an independent magnitude (Xi), and generates new data pairs (Xa,Ya) following the approximation.

The generator has a first part (10) that iteratively determines a current linear regression function to select those of the current regression functions that deliver the approximation to the current set of input values with least error. The parameters (p,q) of the best regression function are then retained, and used by the second part (17) to generate the new approximate pair of data values.

ADVANTAGE - Requires little computational capacity and gives rapid results under controlled maximum error, for use in neural networks or in approximation to measured values in industrial processes.

Dwg.8/15

Abstract (Equivalent): US 5519647 A

An apparatus (5) for generating an approximation function based on first pairs ((X1, Y1) to (X6, Y6)) of values associating a dependent variable (Y1 to Y6) with an independent variable (X1 to X6), and for determining second pairs (XA, Y'A) of values of said variables in accordance with said approximation function, characterized in that the apparatus comprises:

first means (10):

for iteratively determining at least one current linear regression function by making first errors of alternating sign equal in absolute value, which first errors have been measured between, respectively, first values (Y3, Y4, Y5) of the dependent variable for three pairs (X3, Y3) (X4, Y4) (X5, Y5) of a series of pairs, and second values (Y'3, Y'4, Y'5) of the dependent variable determined, in accordance with said current linear regression function, for the same values (X3, X4, X5) of the independent variable,

for selecting that one of the current linear regression functions which produces an approximation of all the pairs of said series with a minimum error, and

for coding the selected linear regression function with the aid of specific codes (p, q), and

second means (17) for determining said second pairs (XA, Y'A) with

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the aid of said specific codes.

Dwg.10/15

Title Terms: APPROXIMATE; FUNCTION; GENERATOR; CALCULATE; FUNCTION; SINE;  
ITERATIVE; DETERMINE; LINEAR; REGRESSION; FUNCTION; ERROR; INPUT; PREDICT  
; APPROXIMATE; DATA

Derwent Class: T01

International Patent Class (Main): G06F-001/02; G06F-015/353

International Patent Class (Additional): G06E-001/00; G06E-003/00;  
G06F-007/38; G06F-015/36

File Segment: EPI

Manual Codes (EPI/S-X): T01-J04D; T01-J16C1

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# RAPPORT DE RECHERCHE EUROPEENNE

Numero de la demande  
EP 94 20 1267

DOCUMENTS CONSIDERES COMME PERTINENTS			
Categorie	Citation du document avec indication, en cas de besoin, des parties pertinentes	Revendication concernée	CLASSEMENT DE LA DEMANDE (Int.CI.5)
A	INTERNATIONAL JOURNAL OF COMPUTER VISION, vol.6, no.1, Avril 1991, NORWELL US pages 59 - 70, XP000215767 P.MEER ET AL 'ROBUST REGRESSION METHODS FOR COMPUTER VISION: A REVIEW' * page 59, colonne de gauche, ligne 1 - page 64, colonne de gauche, ligne 4 *	1-12	G06F15/353 G06F15/36
A	NTIS TECH NOTES, Octobre 1988, . SPRINGFIELD, VA US page 850, XP000051332 'RECURSIVE ALGORITHM FOR LINEAR REGRESSION' * le document en entier *	1	
A	IEEE TRANSACTIONS ON INFORMATION THEORY, vol.38, no.4, Juillet 1992, NEW YORK US pages 1323 - 1338, XP000287141 ADAM KRZYSAK 'GLOBAL CONVERGENCE OF THE RECURSIVE KERNEL REGRESSION ESTIMATES WITH APPLICATIONS IN CLASSIFICATION AND NONLINEAR SYSTEM ESTIMATION' * page 1323, colonne de droite, ligne 38 - page 1324, colonne de gauche, ligne 15 *	1-12	DOMAINES TECHNIQUES RECHERCHES (Int.CI.5) G06F
A	PROCEEDINGS OF THE IJCNN-91-SEATTLE. IEEE PRESS NEW YORK US, vol.1, 8 Juillet 1991, SEATTLE US pages 79 - 84, XP000238272 V.CHERKASSKY ET AL 'SELF-ORGANIZING NETWORK FOR REGRESSION: EFFICIENT IMPLEMENTATION AND COMPARATIVE EVALUATION' * page 80, ligne 10 - ligne 25 *	1	
A	US-A-4 774 685 (H.R.SAMUELS) 27 Septembre 1988 * colonne 2, ligne 45 - ligne 68 *	1-12	
Le présent rapport a été établi pour toutes les revendications			
Lieu de la recherche LA HAYE		Date d'achèvement de la recherche 30 Août 1994	Examinateur Barba, M
CATEGORIE DES DOCUMENTS CITES			
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